# Removing N-Nitrosodimethlyamine (NDMA) From Water

Jere Freeh
New Mexico State University

# Which Would You Drink?


# Water contamination

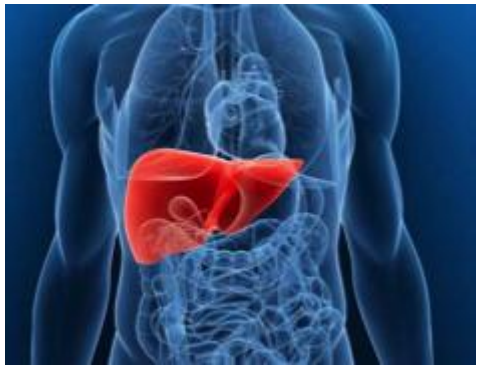
- American EPA has drinking water regulations for more than 90 contaminants
- NDMA is on the contaminant watch list
- European Union does not list nitrosamines in the Drinking Water Directive (Council Directive 98/93/EC)

# N-Nitrosodimethylamine (NDMA)

## Quick Facts

- Probable Human Carcinogen
  - Primary exposure pathway: oral
- Highly mobile in soils
- Highly miscible in water
- Low volatility

## Primary Target Organs

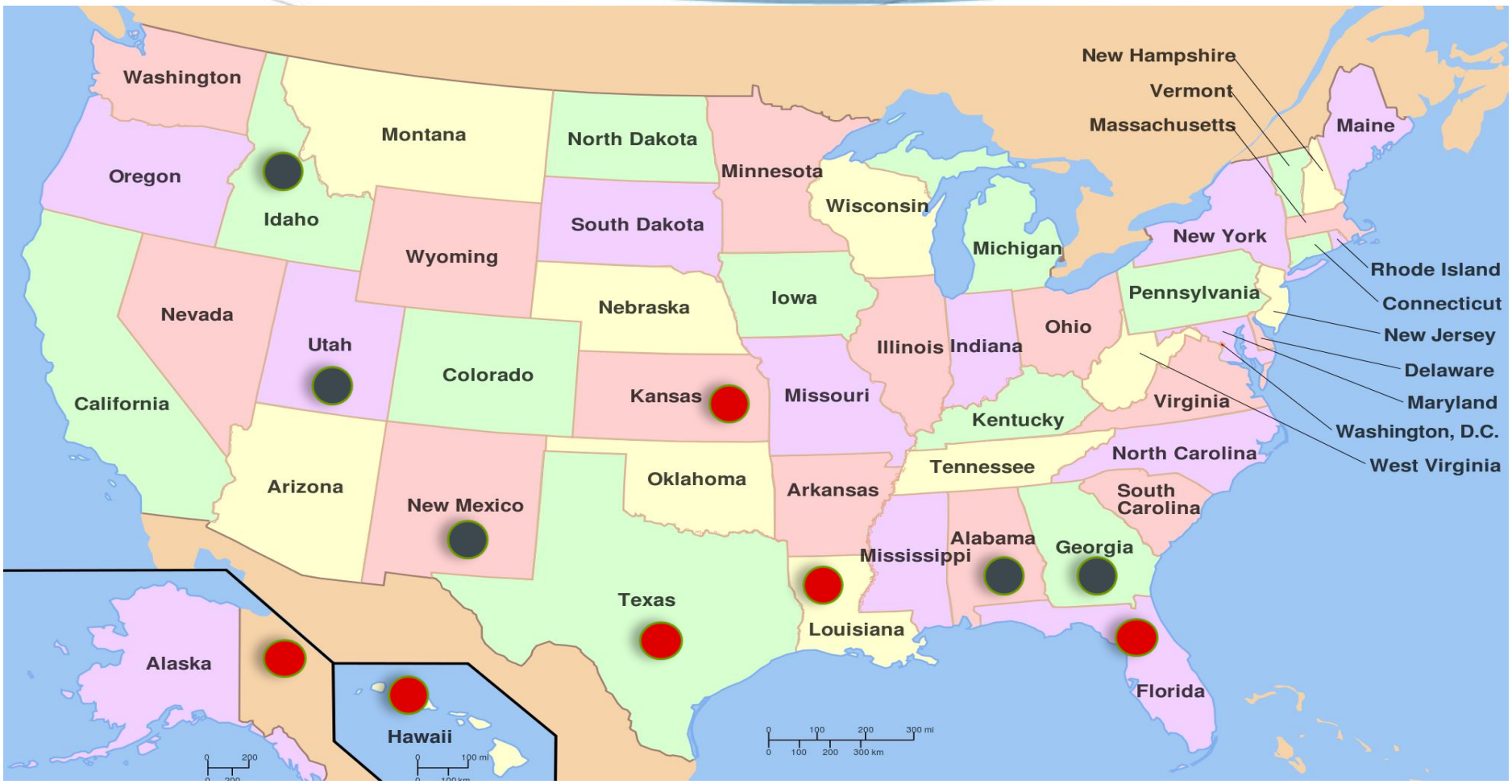


# Source of NDMA Contamination

- **Treated rocket fuel:** Aerozine-50 (50% hydrazine, 50% unsymmetrical dimethyl hydrazine (UDMH))
- At White Sands Test Facility 1960s to early 1970s for the Apollo project
- NDMA first detected in facility groundwater in the late 80's at concentrations of 15,000 ppt

# Additional Sources of NDMA

- Water treatment facilities that use chloramines for treatment
- Fungicide tolyfluanide
- Beer: 0.5 - 9.2 µg/L
- Smoked meats: up to 17.2 µg/kg




Percentage of population served with chloraminated water

- Greater than 50%
- 0 %

Fresh water Systems Inc

# Common Environmental Exposures to NDMA

**Bacon**

6,500 ng/kg

64 in 100,000 chance of developing cancer

Assumes eating 50 g of bacon everyday

**Beer**

500 ng/kg

**Water**

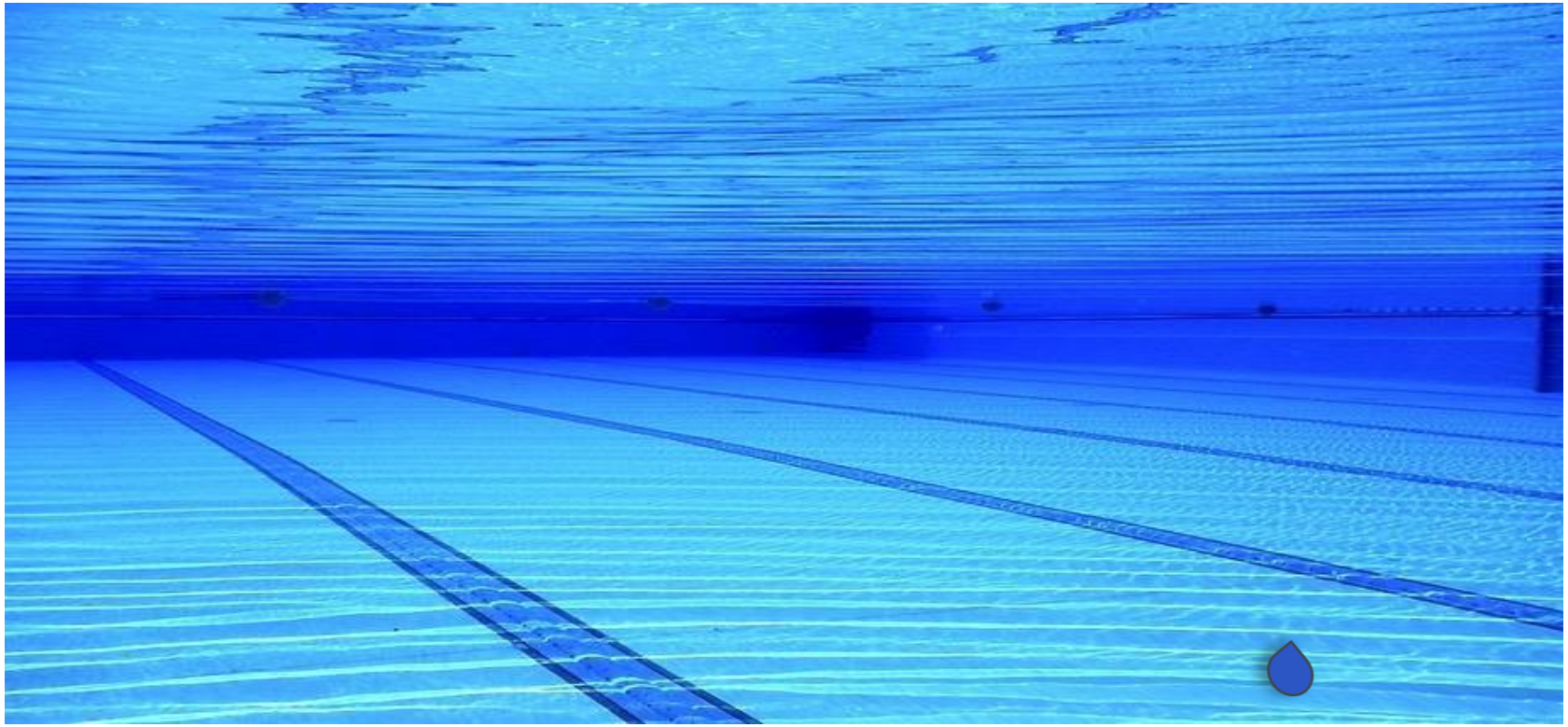
0.42 ng/L

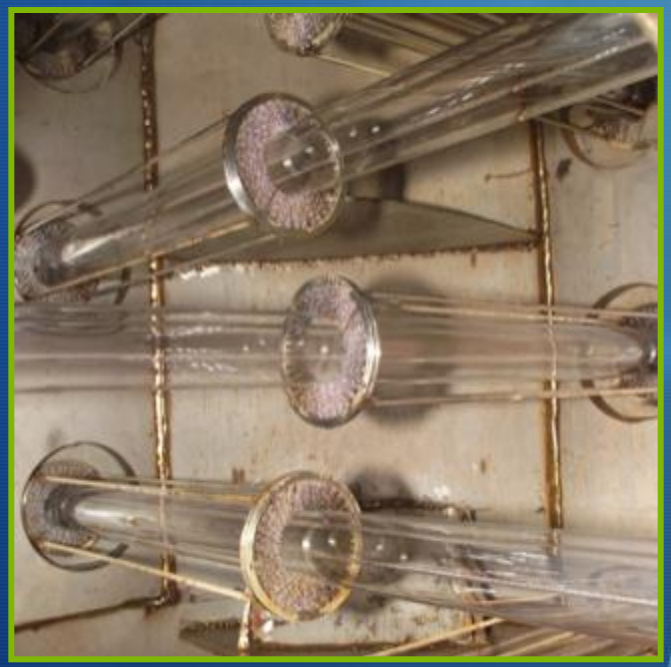
1 in 1,000,000 chance of developing cancer

Assumes 3 L of water per day for a lifetime

# NDMA Removal

- Treat below 10 ng/L (part per trillion)





# NDMA Treatment at White Sands

UV photolysis

- band around 227 nm.

12 30-kW UV (mercury vapor) lamps

- 200 to 250 nm.

Annual electrical cost

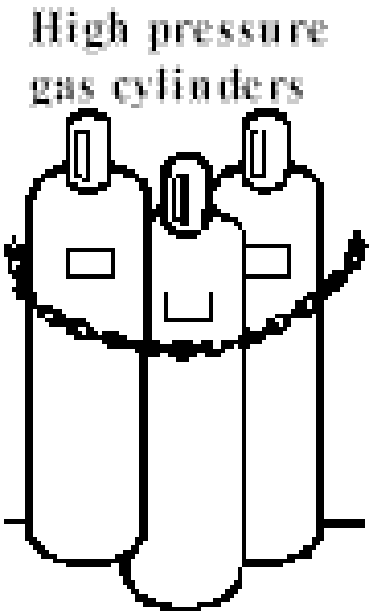
- $112,000 (UV/Ox tower)
- $560,000 (entire system)

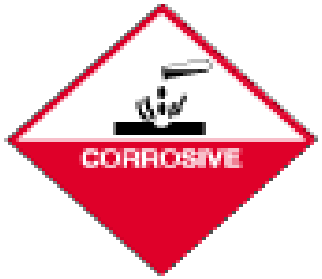
# Goals of My Research

- Treat water to less than 10 ppt
- Provide a cost effective alternative treatment
- Create carbons with the environment in mind

# Logistics…


CAUTION
CANCER SUSPECT AGENT

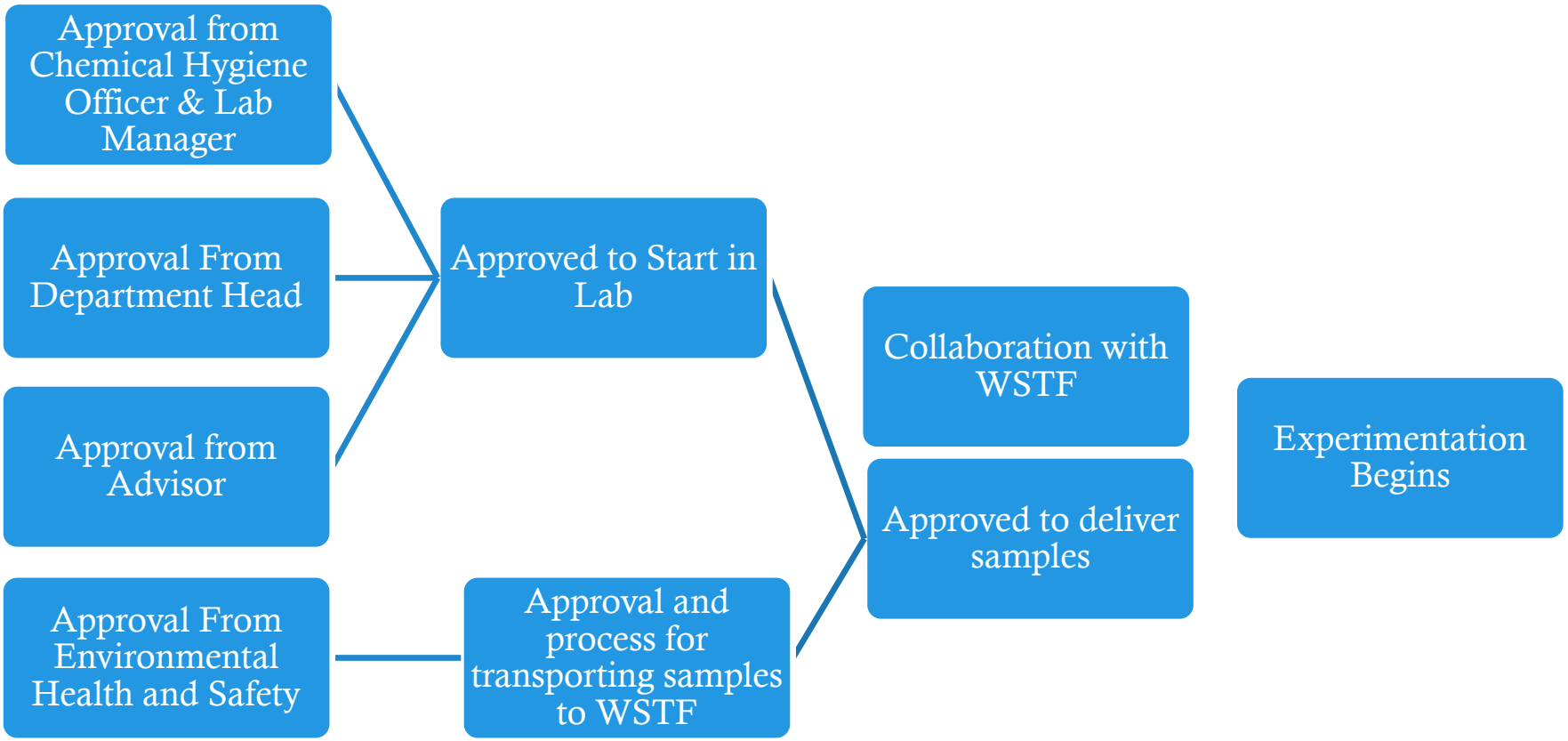

High pressure gas cylinders


CORROSIVE

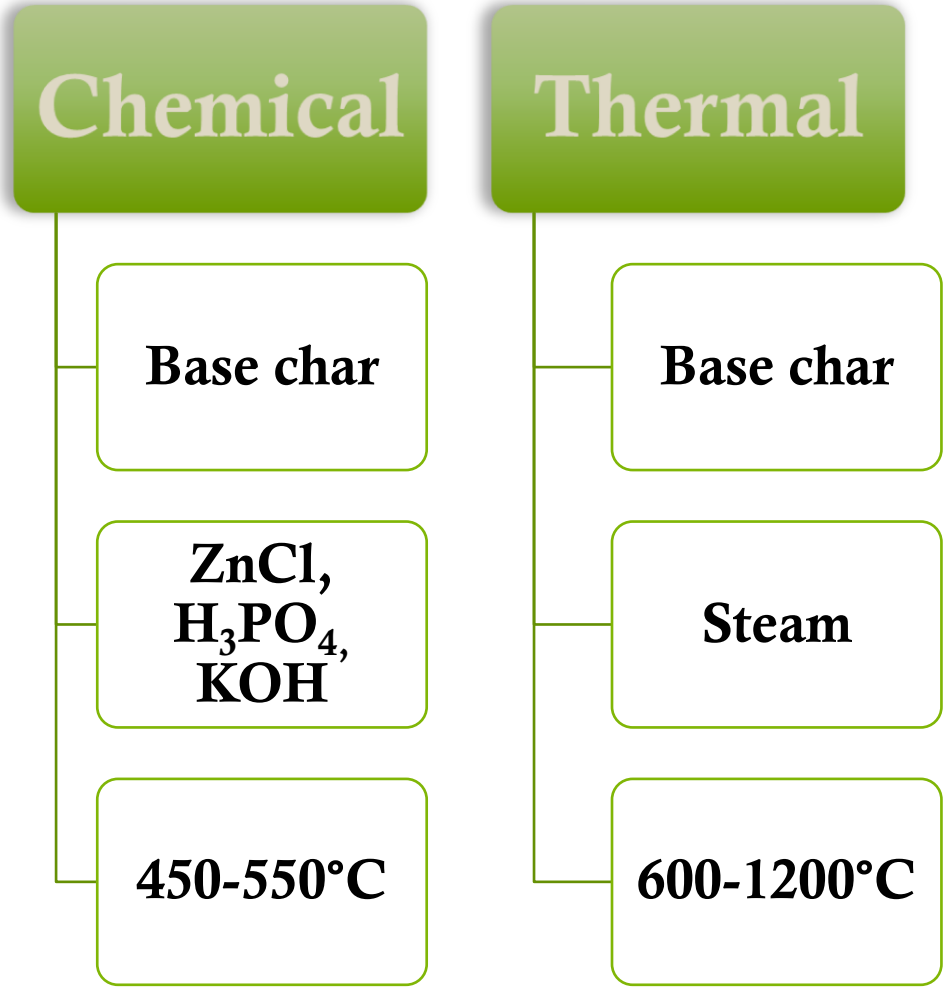

HOT
Caution


CHEMICAL ENGINEERING DEPARTMENT
OFFICE ROOM 259
HOURS 8-12, 1-5
JETT HALL
CLOSED
TO THE PUBLIC
UNDER
CONSTRUCTION

# Logistics


Approval from Chemical Hygiene Officer & Lab Manager
Approval From Department Head
Approval from Advisor
Approval From Environmental Health and Safety
Approved to Start in Lab
Approval and process for transporting samples to WSTF
Collaboration with WSTF
Approved to deliver samples
Experimentation Begins

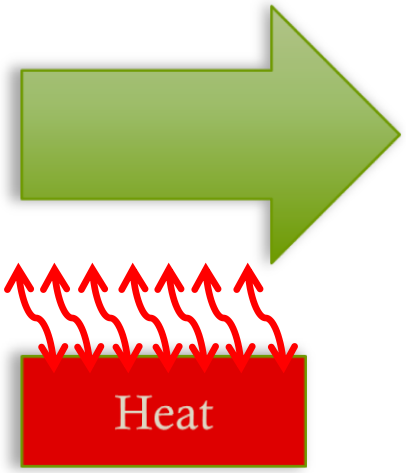
# Carbon Activation



# Char Feedstock: Pecan

- 18 million kg/year in southern New Mexico and western Texas
- New Mexico has 20% of the U.S pecan production
- 4.5 kg of pecan nuts yield 2.2 kg of shell waste
- Shell waste is sometimes used as landscape mulch

# Pyrolysis




# Pecan Shell Char

Raw

2 $m^2/g$

Mostly macropores

450°C

250 $m^2/g$

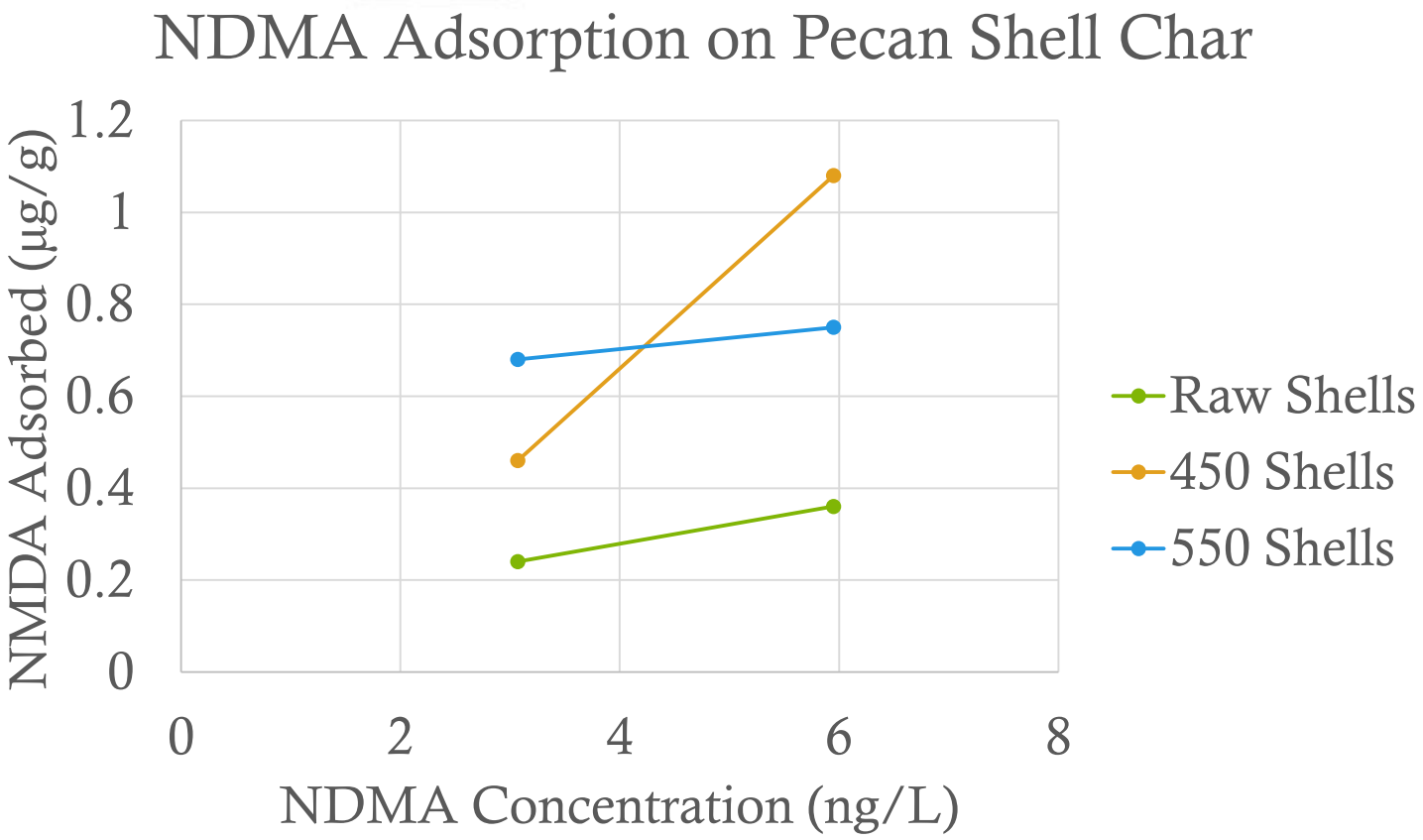
Mesopores/ micropores

550°C

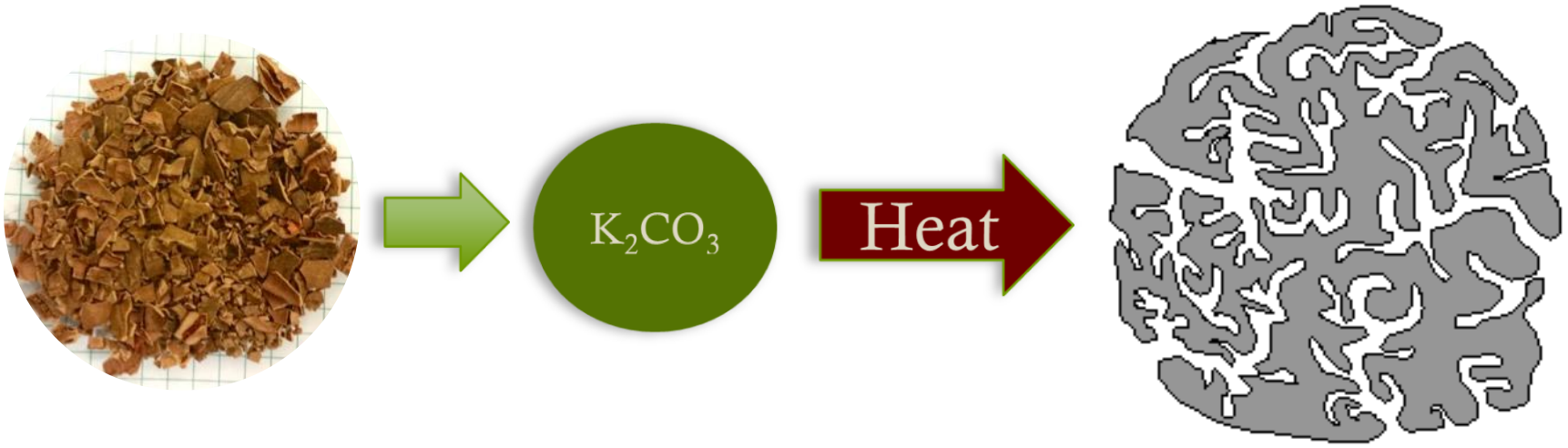
151 $m^2/g$

Mostly micropores

# Preliminary Data



# Activation with $K_2CO_3$



# Next steps

- Expand isotherms for base chars
- Data on activated carbons from base chars
- Evaluate pyrolysis and activation processes
- Estimate adsorption kinetics

# Acknowledgements


- NASA White Sands Test Facility
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- NMSU Environmental Health and Safety



# Questions

Jere Freeh

jaf2@nmsu.edu